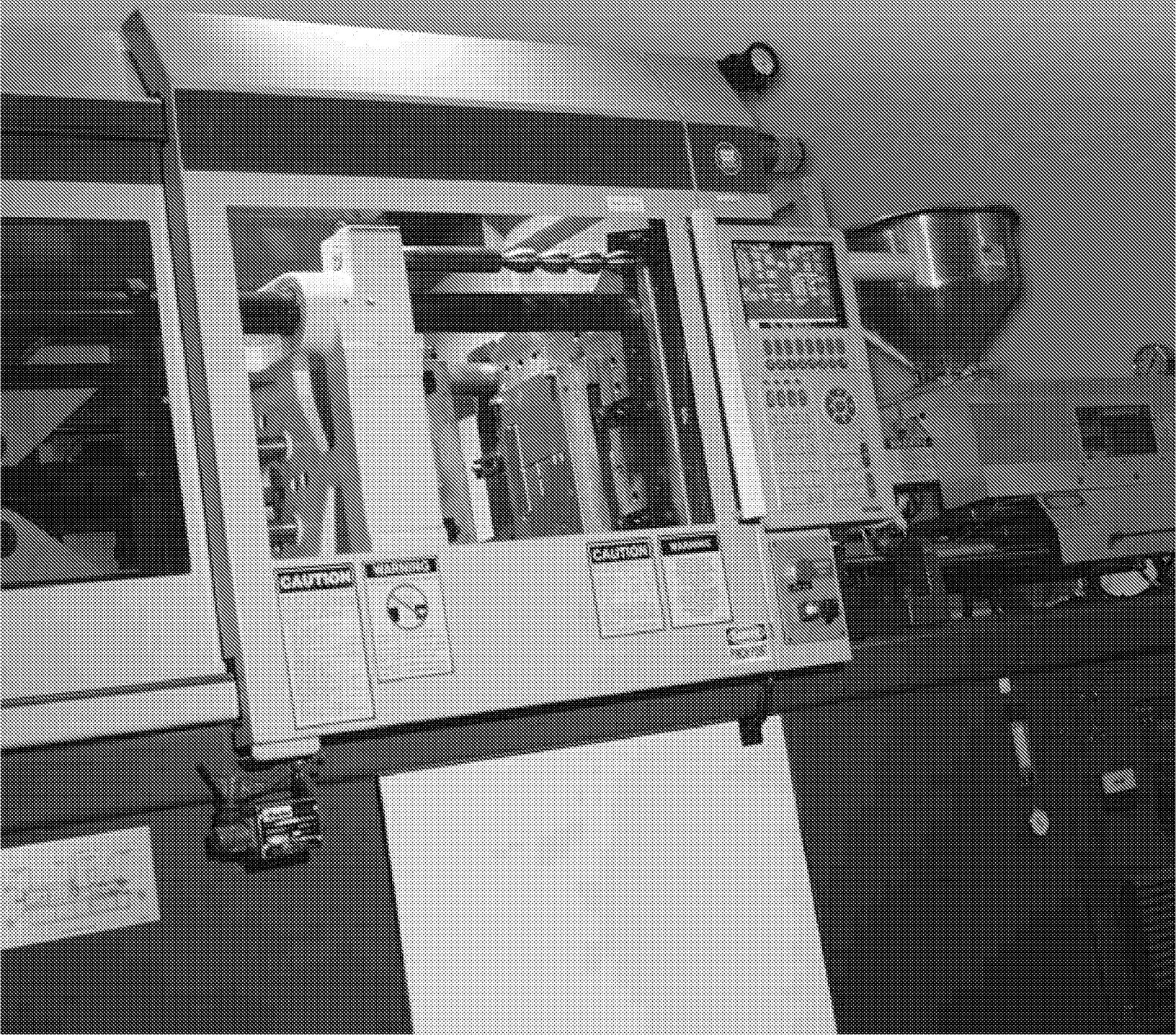


ExxonMobil
Chemical

Polypropylene

Injection Molding Problems & Solutions



POLYPROPYLENE INJECTION MOLDING PROBLEMS & SOLUTIONS

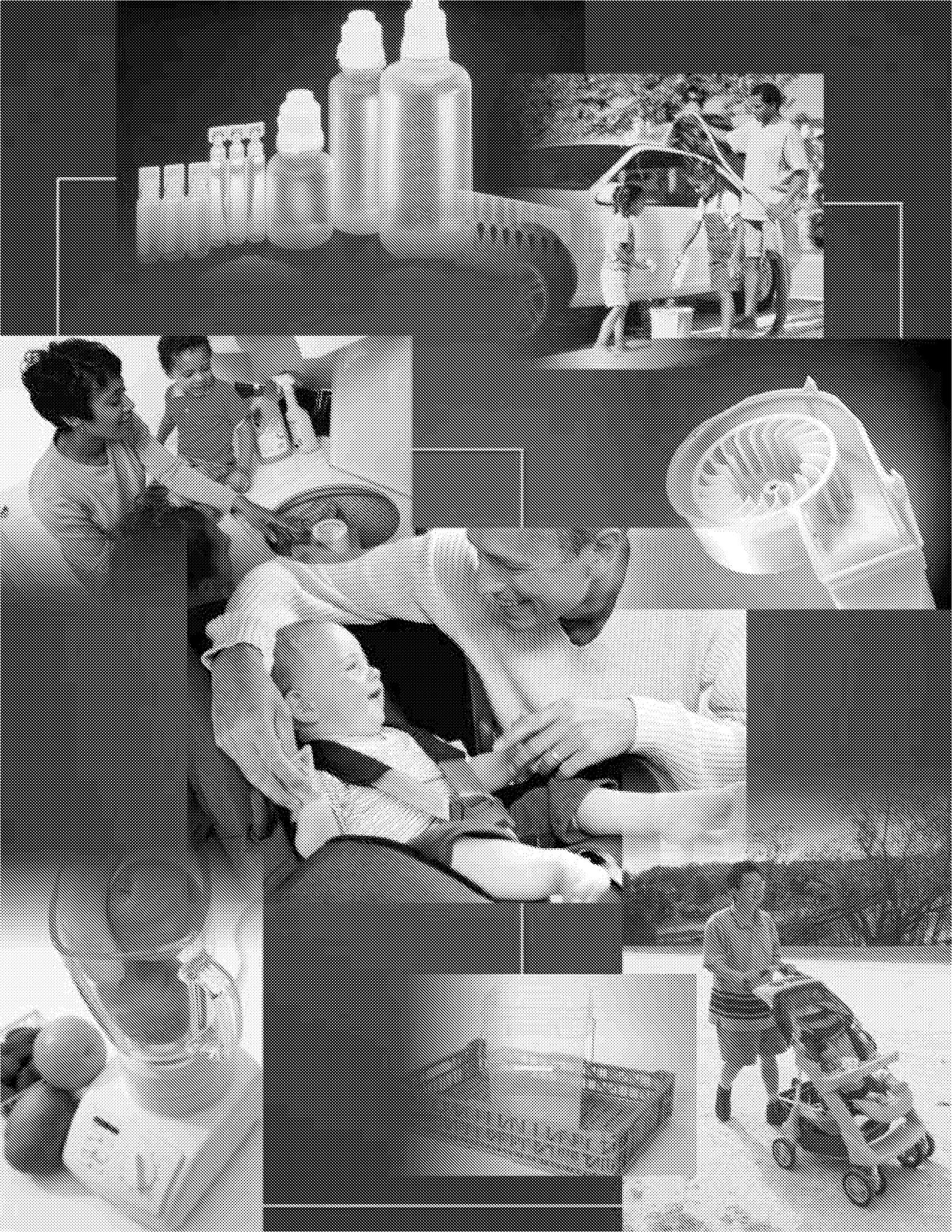
Problem	Causes	Possible Solutions
1. Sink Marks	Part is underfilled or has excessive shrinkage in thicker sections	<ul style="list-style-type: none"> ▪ Increase shot size ▪ Maintain adequate cushion ▪ Increase cavity or hold pressure ▪ Melt or mold temperature too high (if gate freeze-off too slow) ▪ Increase hold time ▪ Reduce fill rate ▪ Cool sink area faster ▪ Open gates ▪ Reduce wall thickness of intersecting rib or boss ▪ Improper gate locations or design
2. Voids	Part is underfilled or has excessive shrinkage	<ul style="list-style-type: none"> ▪ Incomplete mold fill (short shot) ▪ Maintain adequate cushion ▪ Poor venting ▪ Improper gate location ▪ Injection rate too high ▪ Excessive part thickness (+ 0.25 in. or 0.64 cm.)
3. Shrinkage	Volume decreases as plastic cools and crystallizes or part is not fully packed out due to gates freezing off too soon or insufficient cooling time	<ul style="list-style-type: none"> ▪ Excessive shrinkage -- Increase cavity pressure and hold time ▪ Part oversized or not enough shrinkage – Decrease cavity pressure ▪ Maintain adequate cushion ▪ Increase hold time ▪ Delay gate sealing to allow pack out (increase melt temperature) ▪ Mold or melt temperature too high (gates not freezing off) ▪ Improperly balanced cavity and core temperatures ▪ Runners or gates too small ▪ Wall thickness variation
4. Poor Weld Line Strength	The convergence of flow fronts past an obstacle or merging flow fronts in multi-gated molds results in a weak, interfacial bond	<ul style="list-style-type: none"> ▪ Increase peak cavity pressure (fill faster) ▪ Increase mold and melt temperatures ▪ Increase hold pressure and time ▪ Change gate location
5. Flash	Insufficient clamp force, mold surface is deflecting, mold shutoff surfaces not seating properly	<ul style="list-style-type: none"> ▪ Decrease peak cavity pressure (decrease fill rate and/or use profile injection) ▪ Decrease melt temperature ▪ Increase clamp force ▪ Clean mold surfaces ▪ Check mold surface for flatness ▪ Check integrity of mold shutoff ▪ Change gate location ▪ Use larger press

Problem	Causes	Possible Solutions
6. Burning	Compressed air in the mold degrades resin	<ul style="list-style-type: none"> Decrease peak cavity pressure (decrease fill rate and/or use profile injection) Clean vents, increase size or number of vents Reduce melt temperature
7. Warp	Non-uniform stress due to excessive orientation and/or shrinkage	<ul style="list-style-type: none"> Part ejected too hot (increase cycle time) Mold at high temperatures, low pressures, and moderate fill rates Decrease injection fill rate Improperly balanced core and cavity temperature Molded in stress due to low stock temperature and cold mold Minimize hot spots in mold Improperly balanced multiple gates Flow too long, insufficient gates Change gate location
8. Brittle Parts	Excessive orientation, degradation of resin, over packing, contamination, or improper design	<ul style="list-style-type: none"> Increase injection fill rate Increase melt temperature Increase mold temperature and cool time Over packing (decrease hold pressure and time) Degraded material (excessive melt temperature or long residence time in barrel) Contamination from other polymers Use of incompatible carrier resins in color concentrates or other additives Unintentional nucleation from pigments Improper design; inadequate radii at corners, notches, or threads
9. Poor Appearance (Flow marks, low gloss, rough surface, jetting, orange peel, etc.)	Flow front slips-sticks on mold surface, jets, or pulsates	<ul style="list-style-type: none"> Increase cavity pressure Fill speed and/or packing time too low Increase melt and/or mold temperature Cool more slowly Mold temperature non-uniform or too low Insufficient lubrication (internal lubricant or on tool surface) Excessive mold lubricant (e.g. grease bleeding out of the mold) Dirty mold surface (clean and/or polish) Poor pigment dispersion Increase venting Improper gate location or design

General Processing Guidelines

Drying:	Barrel Temperature:	Mold Temperature:	Pressures:	Times (sec):
Generally unnecessary, however, may be required for aesthetic purposes or with highly filled products	Rear – 390-440°F, 199-227°C Middle – 390-450°F, 199-232°C	60-120°F, 15-49°C Cushion: 0.25 in., 0.64 cm.	Boost – 500-1500 psi, 3.45-10.34 MPa Hold – 50-75% of Boost Back – 50-100 psi 34-69 MPa Screw RPM – medium to fast	Boost – 2-10 Hold – Adjust for gate freeze-off Cooling – Depends on part thickness
Melt Temperature: 400-460°F 204-238°C	Front – 390-460°F, 199-238°C			

Problem	Causes	Possible Solutions
10. Sticking in Mold	Over packing, excessive shrinkage, tool design causes physical attachment to the core or cavity	<ul style="list-style-type: none"> » Over packing, injection pressure too high – reduce » Under packing, excessive shrinkage – see solutions to Short Shot » Improperly balanced mold temperatures (colder on movable half) » Reduce cycle time (sticking on cores) » Increase cycle time (sticking in cavities) » Insufficient knockouts » Remove undercuts » Increase draft angles » Surface irregularities in the mold (polish cavity surfaces) » Highly polished core surface (vacuum lock), polish to a coarser finish, apply a surface coating, or increase venting
11. Gate Blush, Delamination or Cracking at the Gate	Melt fracture	<ul style="list-style-type: none"> » Adjust injection speed (increase or decrease) » Modify gate geometry (e.g. gate too small, land too long) » Add cold slug wells in runners » Increase melt and/or mold temperature
12. Black Specks or Discoloration	Degradation	<ul style="list-style-type: none"> » Excessive melt temperature or residence time in barrel » Improper venting » Possible contamination » Excessive screw RPM » Excessive back-pressure » Excessive shear created by the use of a mixing screw
13. Short Shot	Underfilled part	<ul style="list-style-type: none"> » Increase shot size » Inadequate cushion » Increase fill speed, pack pressure, and/or injection time » Increase melt and/or mold temperature » Plugged gates, runners, or vents » Inadequate melt flow rate (use higher MFR material) » Undersized gates, runners, and vents
14. Splay	Streaks on surface caused by volatiles such as moisture or degraded material	<ul style="list-style-type: none"> » Volatiles created by hot spot in manifold » Excessive moisture (dry resin) » Reduce melt temperature
15. Gate Stringing	Plastic strings on parts located at the gates formed during ejection	<ul style="list-style-type: none"> » Increase gate size (reduce orientation) » Decrease melt temperature, increase cooling time » Decrease drop tip temperature » Increase mold opening speed (break strings upon ejection) » Use valve gates



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